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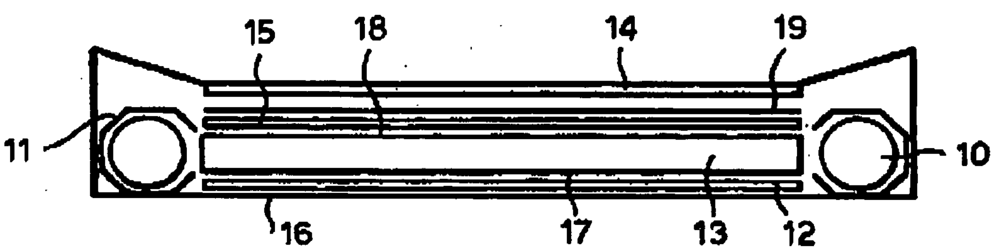
(54) Title: AN EDGE-LIT ILLUMINATION SYSTEM



(57) Abstract

An edge-lit illumination system comprising a light transmitting sheet (13) and a light source (10) is claimed. The light source (10) is positioned in proximity to and adjacent to the light transmitting sheet (13) which has a matrix of etched, painted or screen printed dots covering at least 50 % of at least one of its opposing surfaces. The edge-lit illumination system further comprises a reflective backing material (12) which is spaced apart from and faces one surface of the light transmitting sheet (13) such that it substantially overlies this surface. This system provides for an overall increase in average light intensity from the light transmitting sheet (13) as compared to a system where the reflective backing material is touching the surface of the light transmitting sheet.

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An edge-lit illumination system

The present invention relates to an edge-lit illumination system.

Edge-lit illumination systems which have as a basic feature a light source positioned alongside an edge of a light transmitting sheet are well known. The light transmitting sheet may be treated on one or both of it's surfaces which means that the light entering the edge of this sheet is irregularly reflected or scattered. Therefore the sheet transmits more light than would be expected from the intensity of the light source. Also this light is spread more evenly across the illuminated surface. Examples of such edge-lit illumination systems are EP- A- 0549679 where the light transmitting sheet is an acrylic resin having a matrix of dots applied to substantially all of both surfaces. In one particular embodiment the density of the dot matrix increases in a direction along the light transmitting sheet away from the light source. US-A-5,178,447 discloses an edge-lit light transmitting sheet with an irregular mesh pattern, formed on one of its surfaces, comprising dots of light reflecting material which increase in density in a direction along the sheet away from the light source characterised in that the edge of the sheet through which the light enters is deliberately roughened. US-4,385,343 discloses an edge-lit illumination system where both surfaces of the light transmitting sheet are roughened, preferably in a manner so as to have myriad facets randomly disposed.

Within the basic structure of such edge-lit illuminated systems a reflective backing material may be positioned in contact with at least one of the opposing surfaces of this light transmitting sheet. The backing material is usually of similar physical dimensions to this sheet and placed in contact with it.

It is an object of the present invention to provide such an edge-lit illumination system with a further enhancement in illumination.

Accordingly the present invention provides an edge-lit illumination system comprising a light transmitting sheet and a light source; the light being positioned in proximity to and adjacent to an edge of said light transmitting sheet, said light transmitting sheet having a matrix of etched, painted or screen printed dots covering at least 30% of at least one of its opposing surfaces, and further comprising a reflective backing material wherein said reflective backing material is spaced apart from and faces one surface of said light transmitting sheet such that it substantially overlies said surface.

This invention gives an increase in the overall average output of light intensity from the light transmitting sheet. By average overall intensity we mean an average of light intensity readings measured in Lux at various points across the light transmitting sheet.

The light transmitting sheet is a transparent material. It may be glass or plastic but is preferably plastic and more specifically a clear acrylic sheet. The surface of at least one

side of this sheet is treated with a matrix of etched, painted or screen printed dots, substantially covering at least 50% of the surface. The matrix is defined as a continuous pattern of discrete dots and such pattern may be random. The preferred method of treatment is via screen printing. Preferably the coverage of the matrix of dots is at least 50% and more preferably at least 65% of the surface. When the coverage of the surface with the dot matrix is not substantially all of the surface a part of the surface which is free from the dot matrix may be an area on the surface of the sheet adjacent to the light source extending along the whole edge of the sheet adjacent to the light source. Hence for a dual light source edge-lit sheet there may be two such areas, each at the edge of the sheet adjacent to a light source. In another example at least 90% of the surface may be covered and alternatively substantially all of the surface may be covered with the dot matrix. Preferably both opposing surfaces are so treated.

The dots within the matrix may be of any shape, for example square, round, rectangular, triangular or irregular, for example irregularly shaped generally elongated structures based on squares and/or rectangles. They can be translucent or opaque and are preferably light coloured . By translucent we mean capable of transmitting rays of light with diffusion also. By opaque we mean substantially incapable of transmitting light. Preferably the density of dots is increased in a direction away from the edge of the light transmitting sheet at which the light source is positioned. The density of dots can be increased by increasing the number of dots per unit area and decreasing the spacing between the dots or by keeping the spacing between the dots the same and increasing the size of the dots. Within the matrix the level of coverage for the dots, for example as ink coverage if treatment of the surface is by screen printing, increases from between 0 to 9%, at the edge of the matrix closest to the light source, up to between 10 to 70% at a distance from the edge. More preferably the level of ink coverage ranges from between 0 to 5% to between 10 to 40% and specifically from between 0 to 4% to between 10 to 20%. Alternatively the level of ink coverage may be uniform across the sheet. 10% coverage means that if the whole sheet were covered with a uniform dot matrix then 10% of the total surface area would be covered with ink.

Many types of light source are available but preferably fluorescent tubing is used. The distance from the edge of the light transmitting panel to the crest of the tube is preferably between 1 and 2 mm. The diameter of the tube, D, may vary from typically 6mm, commonly referred to as T2 to 25mm, commonly referred to as T8. Preferably the fluorescent tube is an aperture tube. This type of tube has coated on the inside wall of the glass a reflective coating with a fluorescent coating on top of it. The aperture tube opening is a slot, for example 30 degrees, with no coating that runs the length of the tube and this clear slot is arranged so it is directing light from the light source at the edge of the light transmitting sheet. The light path

length is preferably 1.5D to 100D and more specifically 20.5D to 100D. By light path length we mean for a single light source the furthest distance, along the length of the surface of one side of this sheet, through which light is emitted. For two light sources, adjacent to opposite edges of this sheet, then the light path length is half the distance between the two tubes. Where the light source is at least one fluorescent tube a reflector is typically positioned behind each fluorescent tube and may be any material capable of reflecting light, for example mirrored aluminium. Preferably the light source is in a fixed relationship to the light transmitting sheet.

The reflective backing material may be paper, metal or plastic but is preferably metal or plastic. For example gloss white coated aluminium, styrene, dense white Acrylic gloss sheet (opaque white 1209 available ex Imperial Chemical Industries PLC). The spacing between the reflective backing material and light transmitting sheet is at least 1mm and preferably at least 4mm. It is preferably a constant spacing between the reflective backing material and the light transmitting sheet. The spacing is preferably solely an air gap. The backing material may be held at a constant distance from the light transmitting sheet by spacers at the edges of the backing material or more preferably by a supporting frame around the whole illumination system. The depth of such a frame may be a limiting factor on the maximum spacing achievable between the sheet and the backing gap.

A second light transmitting sheet may be positioned substantially in contact with or spaced apart from the reflective backing material parallel and co-extensive to the opposing surface of the reflective backing material to that of the light transmitting sheet so as to give two sided illumination from the edge-lit system.

Within the basic structure of this edge-lit illuminated system, a diffuser may be positioned substantially in contact with or spaced apart from all of the opposing surface of the light transmitting sheet to that of the reflective backing sheet, for example in a single sided sign where the desired artwork would be positioned on the surface of the diffuser. The diffuser may be translucent or transparent and may be glass or plastic material. Preferably the diffuser is capable of transmitting as much light as possible with some diffusion capabilities also. For example 3mm thickness cast acrylic opal 040 sheet (available ex Imperial Chemical Industries PLC) which has a light transmittance value of 46% or more preferably 3mm thickness 000 clear silk cast acrylic sheet (available ex Imperial Chemical Industries PLC) having a light transmittance of 79% rather than 000 clear cast acrylic sheet (available ex Imperial Chemical Industries PLC) which has a light transmittance of 93%.

The illumination system may be surrounded by a supporting frame. The dimensions of the frame should be sufficient to house the light source(s), electrical and controlling equipment, if present within the frame, and be of sufficient depth to enclose the combined

thickness of the light transmitting sheet, diffuser(s) and reflective backing material, if present. The electrical and control equipment may be situated beside or behind the light source. In the latter case the depth of the frame may be slightly increased but the width of the frame may be narrower. This may be preferred in some signing applications because the visible area of the artwork can be made larger whilst the size of the sign remains the same.

Edge-lit illuminated display systems described in the present invention can be used as lighting devices or light sources as well as advertising displays and also may be modified for use as illuminated shelving.

Specific embodiments of the invention will now be further described in the following examples and with reference to the accompanying drawings (Figures 1 and 2) which represent a section through an illuminated display system according to the invention.

Example 1

In Figure 1 the light transmitting sheet (13) is a rectangular (450mm sheet width by 610mm length (by length we mean the side of the sheet parallel and adjacent to the light source)) 10mm thickness clear cast polymethylmethacrylate sheet which has been treated by screen printing a matrix of white dots directly on to both its opposing surfaces (17 and 18). In this case the matrix covers substantially all of both surfaces and within the matrix the level of ink coverage ranges from about 3% increasing to 16% along the light path length, 225mm (9D), away from each of two fluorescent tube light sources. These are two Sylvania Luxline Plus Daylight Delux fluorescent tubes (10) each of which have a power output of 18 Watts, a colour rendering value (Ra) of 86 ,a colour temperature of 6500 Kelvin and a diameter of 25mm. Each one is positioned adjacent to one of two parallel edges of the light transmitting sheet surrounded by a mirrored aluminium reflector (11). The diffuser (15) is a 3mm thickness cast acrylic Opal 040 sheet having a light transmittance of 46% which is placed in contact with the surface of the light transmitting sheet (13) to which artwork (19) is applied. The backing material (12) is gloss white sprayed aluminium. The illuminated system is housed in a frame (16) with a window (14).

The overall average output of light intensity from the light transmitting sheet is measured as follows: A light meter (RS component part number 1807133) set to F (fluorescent) is used to measure the light intensity (units of Lux) across the light transmitting sheet. The meter is hand held, with the measuring head attached to the meter via a flexible cord, and the sensor has a diameter of approximately 50mm. 9 light readings were taken across the sheet by placing the meter head on the window (14). These were 3 sets of 3 readings taken, one set consisting of a reading taken near the top left hand side of the light transmitting sheet adjacent to one fluorescent tube, in the top middle of the sheet and near the top right hand side of the light

transmitting sheet adjacent to the other fluorescent tube. This was then repeated for the middle of the sheet and the bottom of the sheet. Each set of 3 readings was averaged and then all of these readings were averaged to give one average value for the whole light transmitting sheet. Tables 1, 2, and 3 show the 9 readings taken across the sheet for 0mm, 5mm and 10mm spacings between the light transmitting sheet (13) and the reflective backing material (12). Table 4 shows the overall average output of light intensity values obtained for varying the size of the spacing.

Table 1 - Comparative

	Light Intensities across the sheet in Lux			Avg Light intensity in Lux
0mm Spacing	Left	Middle	Right	
Top	850	860	880	863
Middle	1600	1465	1750	1605
Bottom	930	900	930	920

Table 2

	Light Intensities across the sheet in Lux			Avg Light intensity in Lux
5mm Spacing	Left	Middle	Right	
Top	1265	948	1175	1129
Middle	2410	1565	2075	2017
Bottom	1312	957	1192	1154

Table 3

	Light Intensities across the sheet in Lux			Avg Light intensity in Lux
10mm Spacing	Left	Middle	Right	
Top	1433	980	1500	1304
Middle	3000	1600	2465	2415
Bottom	1690	1050	1520	1420

Table 4

Size of Spacing in mm	Average Sheet Light Intensity in Lux
0(Comparative)	3291
5	4300
10	5139

Example 2

This was a similar experiment to Example 1 except the diffuser material was changed to 3mm 000 clear silk cast acrylic sheet with a light transmittance of 79% . Tables 5 and 6 show the 9 readings taken across the sheet for 0mm and 5mm spacings between the light transmitting sheet (13) and the reflective backing material (12). Table 7 shows the overall average output of light intensity values obtained for varying the size of the spacing.

Table 5 - Comparative

	Light Intensities across the sheet in Lux			Avg Light intensity in Lux
0mm Spacing	Left	Middle	Right	
Top	1100	1104	1180	1128
Middle	2090	1970	2345	2135
Bottom	1178	1182	1335	1232

Table 6

	Light Intensities across the sheet in Lux			Avg Light Intensity in Lux
5mm Spacing	Left	Middle	Right	
Top	1350	1170	1580	1367
Middle	2840	1955	3045	2613
Bottom	1870	1355	1690	1638

Table 7

Size of Spacing in mm	Average Sheet Light Intensity in Lux
0(Comparative)	4495
5	5618

Example 3

This was a similar experiment to Example 1 except the light source was changed to two Philips 'TLD' fluorescent tubes which each have a clear open aperture window of 30 degrees, a power output of 18 Watts, a colour rendering value (Ra) of 86, a colour temperature of 6500 Kelvin and a diameter of 25mm. Tables 8 and 9 show the 9 readings taken across the sheet for 0mm and 10mm spacings between the light transmitting sheet (13) and the reflective backing material (12). Table 10 shows the overall average output of light intensity values obtained for varying the size of the spacing.

Table 8 - Comparative

	Light Intensities across the sheet in Lux			Avg Light Intensity in Lux
0mm Spacing	Left	Middle	Right	
Top	1350	1400	1350	1367
Middle	2710	1650	3060	2807
Bottom	1500	1560	1775	1612

Table 9

	Light Intensities across the sheet in Lux			Avg Light Intensity in Lux
10mm Spacing	Left	Middle	Right	
Top	2345	1285	1867	1832
Middle	4940	1970	4185	3748
Bottom	2700	1410	2065	2058

Table 10

Size of Spacing in mm	Average Sheet Light Intensity in Lux
0 (Comparative)	5786
10	7638

In all of the above 3 Examples an increase in overall illumination has been demonstrated for moving the reflective backing gap away from the light transmitting sheet. The increase is not totally even across the sheet as shown in Tables 1, 2, 3, 5, 6, 8 and 9 but is at a slightly higher value where the light transmitting sheet is adjacent to each of the fluorescent tubes.

Example 4

This Example differs from Example 3 in that the light transmitting sheet dimensions are 450mm by 620mm. In this case the matrix of dots covers substantially all of both surfaces and within the matrix the level of ink coverage ranges from 0% increasing to 16% along the light path length, 225mm (9D), away from each of two fluorescent tube light sources. There is no diffuser present for this Example. The backing reflector gap is 7mm. The overall average output of light intensity from the light transmitting sheet is measured using the light meter as described in Example 1. 15 light readings were taken across the sheet by placing the meter head on the window (14). These were 5 sets of 3 readings taken, one set consisting of a reading taken 65mm along the light path length from the top left hand side of the light transmitting sheet adjacent to the fluorescent tube followed by a reading for the middle of the sheet and one for the bottom of the sheet. 4 further sets of 3 readings were taken at 145, 225, 305 and 385mm respectively along the light path length. Each set of 3 readings was averaged across the light transmitting sheet and the data is displayed in Table 11 as A. Also shown is data B using a dot pattern as described in Examples 1, 2 and 3 and comparative data C using a dot pattern as described in Examples 1, 2 and 3 with no spacing between the reflective backing material and the light transmitting sheet .

Table 11

	Light Intensities across the sheet in Lux					Avg Light Intensity in Lux
	65mm	145mm	225mm	305mm	385mm	
A	3053	3206	3266	3117	2939	3120
B	4453	3283	2955	3090	4327	3622
C (Comp)	1827	1458	1406	1523	1897	1622

It can be seen by comparing A to C there is an increase in the overall illumination from the sheet by spacing the reflective backing material apart form the light transmitting sheet. It can be further seen by comparing A to B that a reduction in the ink coverage of the dot matrix at the edges of the sheet adjacent to each of these tubes shows that the overall increase in illumination is more even across the light transmitting sheet if so required.

Example 5

This Example differs from Example 4 in that a defined area on the surface of the sheet starting at the edge of the sheet adjacent to each light source is free of the dot matrix. The length of

such an area is the full length of the side of the sheet adjacent to the light source. In this case the two areas are 60mm by 620mm, i.e. 27% of the sheet is free of the dot matrix. Table 12 shows this data as D with data B and comparative data C as in Example 5.

Table 12

	Light Intensities across the sheet in Lux					Avg Light Intensity in Lux
	65mm	145mm	225mm	305mm	385mm	
D	2834	3467	3258	3556	3102	3243
B	4453	3283	2955	3090	4327	3622
C (Comp)	1827	1458	1406	1523	1897	1622

It can be seen by comparing D to C there is an increase in the overall illumination from the sheet by spacing the reflective backing material apart form the light transmitting sheet. It can be further seen by comparing D to B that having an area free from the dot matrix at the edges of the sheet adjacent to each of these fluorescent tubes illustrates that the overall increase in illumination is more even across the light transmitting sheet.

Example 6

In Figure 2 the light transmitting sheet (20) is a rectangular (600mm sheet width by 350mm length (by length we mean the side of the sheet parallel and adjacent to the light source)) 8mm thickness clear cast polymethylmethacrylate sheet which has been treated by screen printing a matrix of white dots directly on to both its opposing surfaces (21 and 22). In this case the matrix covers substantially all of both surfaces and within the matrix the level of ink coverage ranges from about 2.8% increasing to 11% along the light path length, 600mm (24D), away from the single light source fluorescent tube (23) which is as defined in Example 1. The diffuser (24), artwork (25), reflective backing material (26), frame (27) and window (28) are as defined in Example 1.

The overall average output of light intensity from the light transmitting sheet is measured using the light meter as described in Example 1. 21 light readings were taken across the sheet by placing the meter head on the window (14). These were 7 sets of 3 readings taken, one set consisting of a reading taken 70mm along the light path length from the top left hand side of the light transmitting sheet adjacent to the fluorescent tube followed by a reading for the middle of the sheet and one for the bottom of the sheet. 6 further sets of 3 readings were taken at 150, 230, 310, 380, 460 and 540mm respectively along the light path length. Each set of 3

readings was averaged across the light transmitting sheet and the data is displayed in Table 13.

Table 13

Spacing in mm	Light Intensities across the sheet in Lux							Sheet Light Intensity in Lux
	70mm	150mm	230mm	310mm	380mm	460mm	540mm	
0 (Comp)	72	58	56	51	50	48	49	384
1	79	63	60	55	54	53	54	419
5	82	69	65	59	57	56	57	444
10	80	66	62	55	54	53	55	425

This Table shows an overall increase in illumination for various levels of spacing between the light transmitting sheet and the reflective backing material as compared to no spacing.

Claims

1. An edge-lit illumination system comprising a light transmitting sheet and a light source; the light being positioned in proximity to and adjacent to an edge of said light transmitting sheet, said light transmitting sheet having a matrix of etched, painted or screen printed dots covering at least 30% of at least one of its opposing surfaces, and further comprising a reflective backing material wherein said reflective backing material is spaced apart from and faces one surface of said light transmitting sheet such that it substantially overlies said surface.

2. An edge-lit illumination system as claimed in claim 1 wherein the density of dots within the matrix is increased in a direction away from the edge of the light transmitting sheet at which the light source is positioned

3. An edge-lit illumination system as claimed in either claim 1 or 2 wherein a second light transmitting sheet is positioned in contact with substantially all of the opposing surface of the light transmitting sheet to that of the reflective backing sheet.

4. An edge-lit illumination system as claimed in claim 3 wherein the second light transmitting sheet is positioned spaced apart from the reflective backing material parallel and co-extensive to the opposing surface of the reflective backing material to that of the light transmitting sheet.

5. An edge-lit illumination system as claimed in any of claims 1 to 4 wherein the matrix of dots covers at least 65% of at least one of its opposing surfaces of the light transmitting sheet.

6. An edge-lit illumination system as claimed in any of claims 1 to 4 wherein the matrix of dots covers substantially all of at least one of its opposing surfaces of the light transmitting sheet.

7. An edge-lit illumination system as claimed in any of claims 1 to 6 wherein a part of the surface which is free from the dot matrix is an area on the surface of the sheet adjacent to the light source extending along the whole edge of the sheet adjacent to the light source.

8. An edge-lit illumination system as claimed in any of claims 1 to 7 wherein the spacing between the or each light transmitting sheet and the reflective backing material is at least 1 millimetre.

9. An edge-lit illumination system as claimed in any of claims 1 to 8 wherein the spacing between the or each light transmitting sheet and the reflective backing material is at least 4 millimetres .

10. An edge-lit illumination system as claimed in any of claims 1 to 9 wherein the light source is a fluorescent tube and the light path length is 1.5 to 100 times the diameter of said fluorescent tube.

11. An edge-lit illumination system as claimed in claim 10 wherein the light path length is 20.5 to 100 times the diameter of the fluorescent tube.

Fig.1.

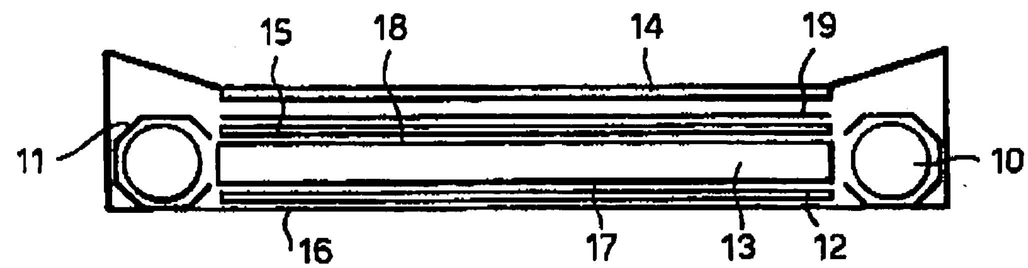
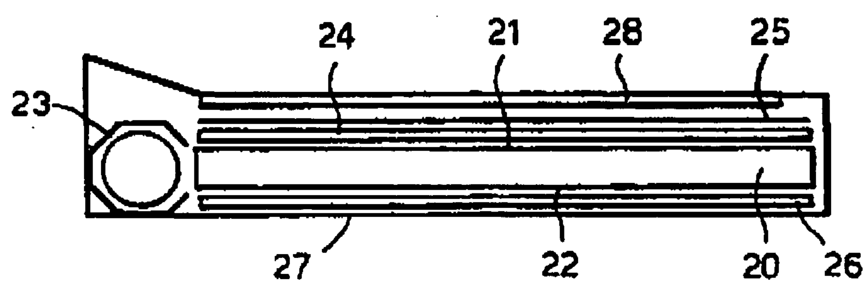


Fig.2.



INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 99/00493

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 F21V8/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 F21V

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP 0 750 209 A (IBM) 27 December 1996 see column 9, line 27 - column 10, line 25; figures 1-16	1-6,10
Y	EP 0 800 036 A (HITACHI CABLE) 8 October 1997 see abstract; figure 1	1,2,10
Y	EP 0 719 981 A (STANLEY ELECTRIC) 3 July 1996 see the whole document	1-6,10
P,X	EP 0 864 905 A (DAI NIPPON PRINTING) 16 September 1998 see column 15, line 5 - line 15; figures 11-15	1

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Information on patent family members

International Application No
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0750209 A	27-12-1996	JP 9005739 A	10-01-1997
		CA 2177919 A	23-12-1996
		US 5764322 A	09-06-1998
EP 0800036 A	08-10-1997	JP 9325221 A	16-12-1997
		CA 2201795 A	04-10-1997
		US 5857761 A	12-01-1999
EP 0719981 A	03-07-1996	JP 2853969 B	03-02-1999
		JP 8179132 A	12-07-1996
		US 5617251 A	01-04-1997
EP 0864905 A	16-09-1998	JP 10293212 A	04-11-1998